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WATER POLLUTION CONTROL, SEWAGE TREATMENT, WATER TREATMENT; SELECTED BIOLOGICAL REFERENCES

William M. Ingram, et al

Robert A. Taft Sanitary Engineering Center
Cincinnati, Ohio

1963

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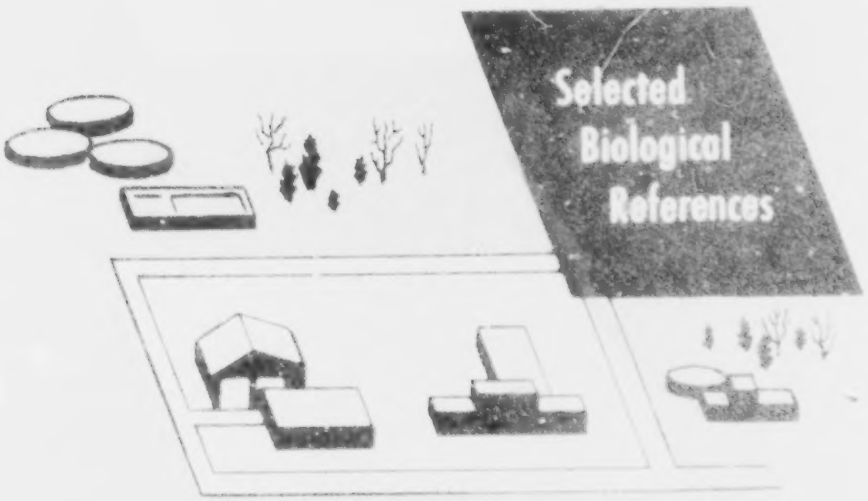

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WATER POLLUTION CONTROL
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Selected
Biological
References

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Preface

This handbook of selected biological references on Water Pollution Control, Sewage Treatment, and Water Treatment is related to two earlier compilations of literature dealing with aquatic biology. These created interest among those charged with the protection of the aquatic resources of our Nation in studies related to environmental investigations of water. Now out of print, the earlier publications were:

(1) Handbook of Selected Biological References on Water Pollution Control, Sewage Treatment and Water Treatment. Public Health Bibliography Series No. 8 (PHS Publication No. 214), pp. 1–66. 1953.

(2) Opt. Cite. Public Health Bibliography Series No. 8 (PHS Publication No. 214—*Revised 1957*), pp. 1–95. 1957.

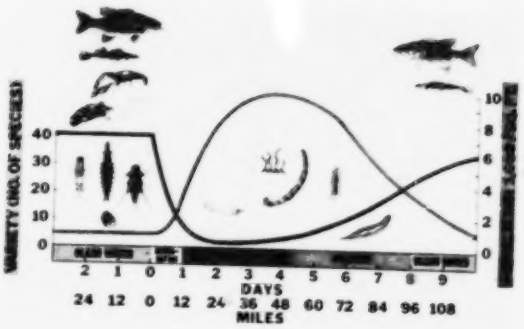
Today all water users are becoming more and more interested in the alleviation of pollution. Full realization of population and industrial growth has brought most persons into intimate contact with problems relating to water degradation associated with municipal, industrial, or agricultural wastes, or a combination of these. Most people fully appreciate that streams, lakes, and estuarine waters remain static in number; it is apparent that problems attendant to waste disposal and water treatment are increasing. Thus, the problems of waste disposal and their reasonable solution are today the concern of all.

In many regions of the United States, history illustrates that land was defiled by over-timbering, over-grazing, and the unwise use of the plow. For many years, one could move away from such destroyed, "polluted land," and still subsist; when this was not possible, people became land conservationists, realizing that in the land lay survival. The history of land depredation could, in the future, be repeated in the depredation of our waters. The number of streams and natural lakes is static with a minimal number of future impoundment sites; there is no moving over a ridge to discover a new waterway. Available waters must be protected for many uses including the maintenance of a healthy biota. All of us should be water conservationists, realizing that water is limited and that in its wise use lies a great part of this Nation's strength. The choice is between barren streams or those containing bountiful, healthy life.

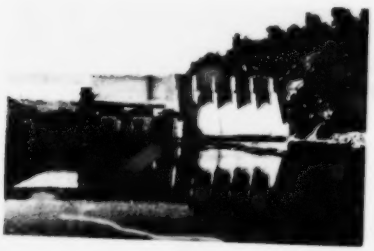
Multiple use of water is the current trend. If pollution is controlled, water can be satisfactorily used for many and varied interests.

With the abatement of pollution, danger from disease is lessened; a better potable water is produced; new industries can be attracted to communities; property values increase; and recreation in the form of fishing, hunting, boating, and swimming is more readily available. To assure adequate water for all of these purposes, water today must be used wisely.

1. Outfall sewer



2. The biota



3. Power dam

Plate I - WATER POLLUTION

SELECTED BIOLOGICAL REFERENCES *on* WATER POLLUTION CONTROL

Selected biological references on water pollution control include a number of related topics ranging from specific groups of organisms to those techniques used to determine changes in the environment and methods used in reporting data.

Much literature is of relatively recent origin. The general expansion of the biological field, the introduction of new factors for consideration, e.g., radioactivity, new insecticides, and a wide range of pollutants for bio-assay, have stimulated research on the short- and long-range impact of these materials. New techniques have been devised, and a number of ideas proposed to make the collected data more comprehensible to others. Much research pursuing a varied attack has been directed to specific topics—algae, plankton, fungi, aquatic insects, aquatic benthic organisms, fish, and flowering aquatic plants.

The presentation of collected data probably requires as much additional exploration as any single topic. The broad field to which these data are directed contains many associated disciplines and the existence of full and mutual understanding becomes imperative. Collecting data is not enough: their meaning must be understood by the engineer and the chemist who may have correlative information.

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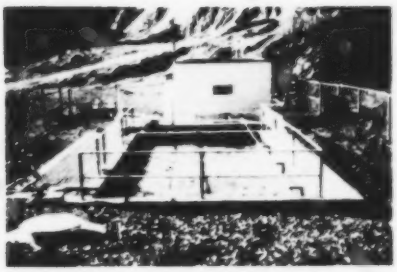
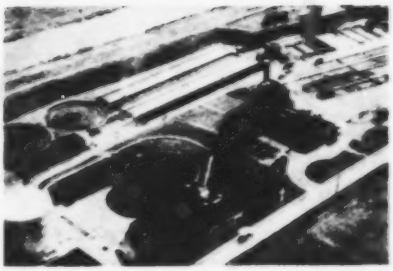


1. Small activated sludge plant using extended aeration



2. Activated sludge sewage treatment plant

3. Trickling filter in operation

Plate II - SEWAGE TREATMENT

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SELECTED BIOLOGICAL REFERENCES *on* SEWAGE TREATMENT

Organisms that are adapted to the treatment of sewage have long fascinated the professional investigator. Early efforts, of necessity, dealt with a determination of the types of organisms present in various sewage treatment processes. Later, interest was focused on the specific role played by particular organisms in activated sludge and trickling filter systems. Needless to say, there is still a void waiting to be filled with study on organism response to in-plant operational modifications.

Rather recently, sewage stabilization ponds have captured the interest of the sanitary engineer. Since these are typically shallow lakes that undergo eutrophication [1] at a relatively rapid and constant rate, they have also provided the biologist with a new field of study. Much recent literature is devoted to a thorough investigation of pond limnology [2] under different waste load and climatic conditions.

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[1] Eutrophication—The intentional or unintentional enrichment of water.
[2] Limnology—The study of the physical, chemical, and biological aspects of inland waters.

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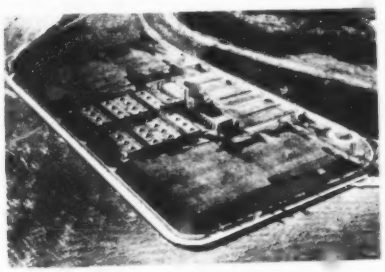
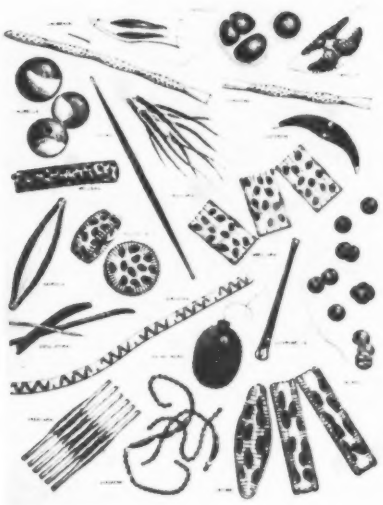
1. Water purification plant





2. Filter clogging algae

3. Finished water distribution tank

Plate III - WATER TREATMENT

SELECTED BIOLOGICAL REFERENCES *on* WATER TREATMENT

As opposed to the role of organisms in sewage treatment, few organisms in water supplies are considered beneficial. Instead, they become of public concern and great and constant effort is expended in bringing organism-free water to the consumer.

Much of the literature in this section concerns organisms occurring in raw water supplies, as well as in the treatment plants and distribution systems. Keeping track of organism population abundance, eliminating tastes and odors, and devising possible control measures in the reservoir and in the treatment plant are problems that have concerned water supply biologists for a number of years. Since reservoirs are specialized lakes, the problems involved may be many and varied often demanding specialized attention and thoughtful consideration of the impact of a particular control effort upon the overall supply.

Subgroups within this section consider the problems and possible remedial measures as they relate to the various aspects of water supply and treatment.

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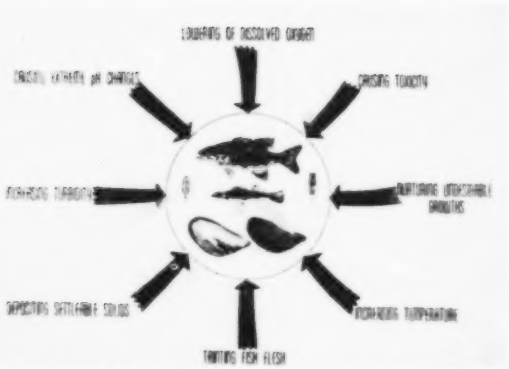
1. Industrial complex



2. Ways in which industrial wastes may affect aquatic life

3. Activated sludge treatment of textile wastes

Plate IV - INDUSTRIAL WASTE WATER

SELECTED BIOLOGICAL REFERENCES *on* INDUSTRIAL WASTE WATER

Population and industry have expanded tremendously in recent years, but streams, lakes, and estuarine waters have remained static in number. Thus, the problems of waste disposal and their reasonable solution are today the concern of all.

Industrial waste effluents bring about environmental changes that may be potentially dangerous to aquatic life. Such changes include: decrease in dissolved oxygen to harmful levels; increase in turbidity; formation of sludge deposits by settleable solids; increase in chemicals to toxic levels; changes in pH toward extremes in acidity or alkalinity; increases in temperature; tainting of fish flesh; production of nutrients resulting in undesirable aquatic growths; and concentration of radioactive materials in aquatic life.

Because of this great diversity of impact upon the environment, and in many cases the lack of information on a specific industry, many general industrial references appear in the section "Selected Biological References on Water Pollution Control." The reader is especially referred to the subgroups, "General References" and "Toxicity and Bio-assay Methods."

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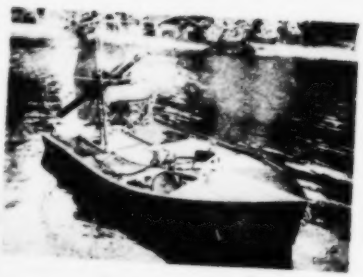
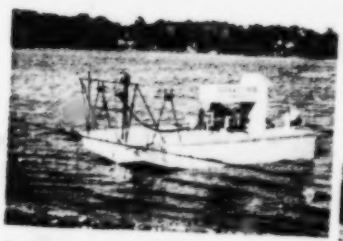
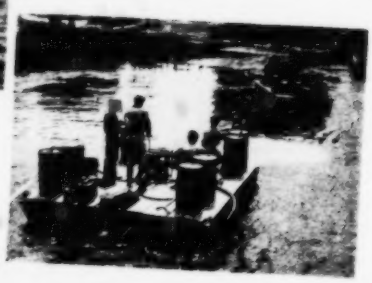
1. Mechanical weed cutting and removal

2. Air boat application equipment





3. Chemical distribution by boom spraying



4. Chemical distribution through pressure spraying

Plate V - RECREATIONAL WATER TREATMENT

SELECTED BIOLOGICAL REFERENCES *on* RECREATIONAL WATER TREATMENT

Since 1900, the population of the United States has tripled while water use has jumped eight-fold. Likewise, the treatment of recreational waters to control aquatic pests and developing nuisances has expanded to meet increased water utilization.

Initial experimentation in recreational water treatment occurred soon after the turn of the century. Moore and Kellerman described the control of algae with copper sulphate as early as 1904, and Domogalla used this chemical in a large scale treatment program on the Madison, Wis., lakes in 1918. Sodium arsenite was used to control submerged aquatic plants in recreational waters by Domogalla in 1926, and Surber (1927) used the same chemical to control nuisance vegetation in fish rearing ponds. W. W. Cort was first to demonstrate the presence in Michigan waters of an organism that penetrated the skin of bathers and produced an irritating rash. In 1938, the Wisconsin Committee on Water Pollution began using a chemical in natural bathing areas to control snails determined to be the intermediate host of the organism causing this rash.

From these early efforts, recreational water treatment has expanded to include related water problems and has intensified to meet the challenge of increased water utilization. Man-created enrichment, usually resulting in algal blooms and nuisance weed growths, is an ever present problem. Water enrichment associated with siltation, turbidity, water color, temperature, available sunlight, water movement, and the size, shape and slope of the lake basin greatly influence nuisance organisms. Increased population pressures and the concept of multiple water use have brought the aquatic nuisance problem to the attention of all who are concerned with recreational waters.

Aquatic nuisances may interfere with industrial use of water; hamper water treatment; impart tastes and odors; lower shoreline property values; destroy scenic beauty; curtail bathing, boating, water skiing, and fishing; reduce or cancel resort trade; and exhibit properties that are toxic to some animals. Once a nuisance develops, appropriate control measures receive profound consideration by those intimately associated with the problem.

682 468 63 9

The control of excessive aquatic growths and other lake nuisances often becomes a necessity in order to fully utilize the water resource. Certainly, the most adequate form of control would be complete removal of the nuisance from the lake basin. Financial and practical considerations, however, often dictate the type of control attempted.

There has never been complete satisfaction with those chemicals used in the control of aquatic nuisances. An ideal chemical should be safe for the applier to distribute, should kill or control the specific nuisance, be nontoxic to fish and most fish-food organisms at the applied concentration, should not prove seriously harmful to the environment or ecology of the general aquatic area, and be economically feasible. Consequently, the search continues and researchers are currently looking at the many possible processes and agents that might be used in control efforts and which might come just a bit closer to the ideal control agent.

The application of a chemical control agent to water involves certain hazards, which must be recognized and against which public rights must be protected. The short and long range toxicity to all aquatic life, the deposition and possible accumulation of the chemical upon the lake bottom and the subsequent reaction upon the community of bottom organisms, the impact resulting from the destruction of too much biological growth at one time, and possible disturbances within the general aquatic environment are all factors that have been considered in the literature in connection with many of the chemical control agents now being used or considered. Although the process of determining the effects of a control agent is often tedious, it is of equal or greater importance than the initial development of the agent.

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1. Clean stream inhabitants

2. Tolerant Diptera Larvae

3. Submerged aquatic plants

Plate VI - ORGANISM IDENTIFICATION

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SELECTED BIOLOGICAL REFERENCES

on ORGANISM IDENTIFICATION

Specific identification of organisms is a necessary and integral part of biology; it is therefore important that the biologist speak and write in language that is understood.[1] Much has been said, and justly so, on the merits of understanding the fellow scientist. Usually the principal barrier is the specialized language of the discipline. Unfortunately, perhaps, common names either have not been proposed for a host of organisms or have such broad application to a group that they become meaningless. Thus, each organism has a generic and a specific name and each may be identified by a specific characteristic not found in other forms.

Keys to differentiate species are often developed as a particular group of organisms are studied or as new forms are found and described. Later, keys are assembled in books or monographs complete and current to the publication date.

An attempt has been made to list those publications commonly used by the biologist in identifying organisms in the water supply and water pollution control field. No effort has been made to cover that vast amount of taxonomic literature that is available on many of the groups of organisms.

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1. Salmon and steelhead fishing on Columbia River

2. Popular bathing beach

3. Fish kill produced by dense algal growth

4. Recreation, a legimitate water use

Plate VII - ASPECTS OF WATER QUALITY

SELECTED BIOLOGICAL REFERENCES

on ASPECTS OF WATER QUALITY

The biological aspects of water quality receive special consideration in a large number of books, journals, bulletins, and reports. Two of these media have been grouped in this section with the hope that the references will prove useful to those closely associated with the biological profession. An effort has been made to list those books that are devoted wholly or in part to a discussion of water quality and its study, and the major journals devoting space to papers in this field: bulletins and reports have not been cited because they are so numerous.

The biologist cooperates with various professions such as sanitary engineers, chemists, waste treatment engineers, waterworks engineers, soil scientists, limnologists, etc.: thus he is prone to publish his data in the journalistic media allied with the discipline most closely connected with the particular research.

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17. *Public Health Engineering Abstracts*
    Public Health Service, Washington, D.C. (Monthly)

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21. *Water and Sewage Works*
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22. *Water Pollution Abstracts*
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23. *Wisconsin Academy of Sciences, Arts, and Letters Transactions*, Madison, Wis.

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